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Antonio COPPOLA

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For: A SWITCH WITH A THERMOPROTECTION

CLAIM FOR PRIORITY

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

November 20, 2003

Sir:

The benefit of the filing dates of the following prior foreign applications in the following foreign country is hereby requested for the above-identified patent application and the priority provided in 35 U.S.C. §119 is hereby claimed:

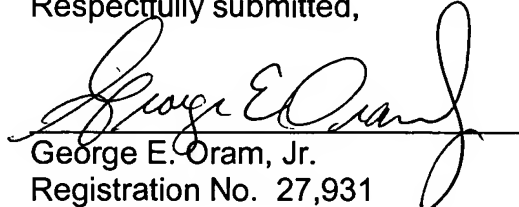
European Patent Application No. 03425641.2 filed on September 30, 2003.

In support of this claim, a certified copy of said original foreign application is filed herewith.

It is requested that the file of this application be marked to indicate that the requirements of 35 U.S.C. §119 have been fulfilled and that the Patent and Trademark Office kindly acknowledge receipt of these document.

Please charge any fee deficiency or credit any overpayment with respect to this paper to Deposit Account No. 01-2300.

Respectfully submitted,


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Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. Patent application No. Demande de brevet n°

03425641.2

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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Sheet 2 of the certificate
Page 2 de l'attestation

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The present invention relates to an electric safety switch and, more particularly to a switch for electrical apparatus for which a permanent stopping is required to be ensured, but that can be drivingly reput in service in
5 all cases of wrong use of the apparatus or malfunction of the apparatus itself or of the switch, or in case of unforeseen or predetermined change of the thermal situation of the environment controlled by said switch.

10 For better understanding of the technical problem tackled by the invention it is to be considered first of all an electric motor failing to properly function due to mechanical inconveniences (seizure of the bearings, for example) or electrical inconveniences (a short-circuited
15 winding) hindering or inhibiting rotation of same.

These motors are protected by a safety device, also known as a remote control switch, generally consisting of a pair of metal plates inserted in the supply circuit and
20 usually mutually closed. On passage of an electric current of a higher intensity than the preestablished one, the plates mutually separate and deform by Joule effect, thereby breaking the supply circuit. As temperature comes back to its usual value the plates
25 approach again and power to the motor is restored.

In the above assumed case, by putting the switch in service the motor is powered but, due to its being restrained from rotating, the intensity of the supply
30 current running through the circuit increases until the predetermined threshold value is overcome. Intervention of the remote control switch puts the motor out of service until cooling of said plates, the motor being then automatically reput in service. If this malfunction
35 is not detected by an operator, a series of interventions of the remote control switch occur that cyclically put

the motor in service and out of service. However, these continuous current pulses of high intensity cause heating of the electric circuits of the motor and, by conduction or convection, of the devices connected therewith too, such as the switch and remote control switch, which is dangerous for the physical integrity of same. Practically, interventions of the remote control switch go on until physical destruction (by melting for example) of the latter or any other part of the apparatus.

It may also happen that the repeated opening and closing cycles of the contacts in the remote control switch cause locking of the remote control switch itself due to welding between the contact points of the plates, as a result of the electric arc taking place between said points at each opening and closing movement of the contact.

Due to this inconvenience, since the motor is always powered, an irreparable damage to the apparatus itself is caused so that said apparatus needs to be replaced and there is also a serious risk for the machine operator's safety.

The case is now contemplated in which a motor planned for an intermittent use is on the contrary utilised in a continuous service. In this case the supply current will never overcome the predetermined threshold value so that intervention of the remote control switch is never required. However the corresponding Joule effect heats the different parts of the apparatus, many of which are made of plastic material with a low melting point that hardly bears overheating due to such a use, so that temperature is brought to damaging and dangerous levels.

As a consequence, a quick out-of-use of the apparatus is obtained which will involve expenses for servicing,

repair and replacement of the damaged parts.

The case of a heating apparatus; an oil radiator or an electric heater is finally taken into account: these
5 apparatus are provided with an electric resistance heating an intermediate fluid (oil) or directly heating the environmental air and are controlled by a thermostat starting and shutting off the supply circuit of the electric resistance depending on the result of a
10 comparison between the temperature set on the thermostat and the ambient temperature.

If a cloth (towel, linen, duster) is accidentally or intentionally placed on the heating apparatus, against
15 the constructor's instructions or regulations, this cloth will hinder spreading of heat generated by the electric resistance towards the surrounding environment causing an important rise in the temperature of the environment confined between the cloth and the stove. If the
20 thermostat is inserted in the stove, as it usually happens, it feels the temperature rise and breaks the electric supply circuit, but the electric resistance and the materials connected therewith go on giving heat off over a certain period of time causing a further rise in
25 the temperature level in the stove and the space included between the stove and the cloth. When temperature then goes down, the thermostat closes the electric circuit giving rise to a new heating cycle. In this case too, the continuous thermal cycles damage the weakest parts of the
30 stove in an irreparable manner.

It is to be pointed out that none of the control and/or protection devices known, thermocouples, remote control switches, thermostats for example, are able to eliminate
35 these drawbacks. There are already on the market safety switches that in case of malfunction of the protected

apparatus definitively stop the electric supply circuit but this interruption takes place with destruction of the switch. This expedient involves costs and periods of machine stop for replacement of the destroyed piece and
5 is therefore uneconomic and too drastic in the cases in which a malfunction, if identified in due time, could be easily eliminated thereby avoiding the consequent damages.

10 Through examination of the mentioned cases the Applicant has become aware of the fact that there is a technical problem consisting in that all known protection devices act on the supply current of the electric circuits as a primary source of heat production but do not consider the
15 effect resulting from heat accumulation, possibly also in the absence of electric power.

The Applicant has perceived that the identified technical problem could be solved with a device of a new type,
20 capable of simultaneously ensuring full safety, functional character, reliability and low cost, which is adapted to act on the electric supply circuit of an apparatus depending on the perceived heat level, carrying out a single automatic intervention on said circuit with
25 subsequent stopping of the device, with the possibility however of restoring operation of the device itself in a non-automatic manner after each intervention.

Accordingly, the invention relates to a safety switch, in
30 particular for supply circuits of electric machines, comprising the features set out in the characterizing portion of claim 1 and in the claims depending thereon.

More specifically, the invention relates to a safety
35 switch, in particular for thermal protection of an electrical apparatus, comprising a container inside which

means for activation of said switch is housed, said means comprising a command key and a pair of contact carriers, movable relative to each other, each of them being connected with a terminal of its own of an electric circuit, at least one of said contact carriers being swingable between two positions, an open position at which said contact carriers are separated from each other and respectively a closed position, at which said contact carriers are in mutual contact, each of said positions being imposed by a corresponding position of said command key, said switch being characterized in that said activation means comprises a (thermoprotector) device responsive to temperature variations in the environment to be controlled and adapted to act on the electric supply circuit of said apparatus depending on the perceived heat level, carrying out a single action on said circuit, the possibility of reuse of the device after said action being bound to the intervention of an operator.

Further features and advantages of the invention will become more apparent from the detailed description of a preferred but not exclusive embodiment of a switch in accordance with the present invention. This description will be taken hereinafter with reference to the accompanying drawings given by way of non-limiting example, in which:

- Fig. 1 shows a pair of switches, of which at least one is in accordance with the invention, that are inserted in a single support plate and seen in front view from the command side;

- Fig. 2 shows a switch in accordance with the invention, seen in cross section along the plane A-A in Fig. 1, in an active position and with a thermal protector hooked thereto;

Fig. 3 shows the switch in Fig. 2, in a passive position

and with a thermal protector hooked thereto;

- Fig. 4 shows the switch in Fig. 2 in a situation of fault of the system in a passive position and with a thermal protector unhooked therefrom.

5

In the present description longitudinal direction stands for the direction of the key displacement plane, transverse direction stands for that of the oscillation axis of the movable contact carrier, radial direction
10 stands for the direction perpendicular to the plane containing said longitudinal and transverse directions.

In a preferred embodiment, the switch of the invention comprises (Fig. 2) an open container 1, of insulating
15 material, preferably a plastic material, within which means 2 for activating said switch is housed. Said means preferably comprises a command key 3, a pair of contact carriers 4 and 5, at least one of which is movable with respect to the other, said movement being controlled by
20 said key 3, and a thermoprotector device 6. Said key 3, in a manner known by itself, preferably has a T-shaped conformation, where the "T" arms 3a, 3b are extended in a longitudinal direction and the "T" leg 3c in a radial direction; it rotates in a longitudinal direction, in the
25 two ways around a transverse rotation axis R-R, passing through the "T" leg and parallel to said oscillation axis.

The container, on its outer side surface, is preferably
30 provided with devices 100 enabling easy mounting of same, by restrained fixing, in a corresponding window formed in a side of the apparatus for which it is intended. Along its open edge the container has a flange or plate 101 for coupling by abutment against said wall of the apparatus.

35 Such a flange performs an aesthetic function as well, to make the outer appearance of the switch agreeable (Fig.

1) and also has a functional character as it carries graphic symbols such as the constructor's name or trademark and information about the position of key 3.

5 Provided inside the container is a separating baffle 10 which is substantially oriented as the flange and will be hereinafter defined as the container floor: inserted in said floor is a pair of electric terminals 7, 8, referred to as first 7 and second 8 terminals respectively, for
10 connection with the electric circuit controlled by the switch.

Preferably said pair comprises two plates 7, 8 of electrically conductive material, projecting from said
15 floor and facing said key. Said plates preferably also project externally of the container, coming out of the container floor: these projecting portions, in use, are connected to corresponding lead-in wires (not shown) of the conductors of the electric system to be controlled.

20 Plate 7 constitutes a laminar support for the movable contact carrier; more preferably the plate end 7 extended within the container, acts as a fulcrum for said contact carrier, and oscillates like a rocking lever around said
25 fulcrum in a transverse oscillation axis O-O, parallel to axis R-R.

Preferably, the oscillating contact carrier 4 (Fig. 3) comprises a tilting contact element 40 of a U-shaped
30 configuration the base of which rests on said fulcrum and at least one of the two sides of which is provided, at the free end thereof, with a flange 41 projecting in cantilevered fashion from said end and extended in a longitudinal direction, away from the oscillation axis.
35 Fastened to this flange is an electric contact point 42 preferably consisting of a drop of a suitable conductive

material, welded onto the surface of said flange. More particularly, the contact point 42 is fastened to the surface of flange 41 facing the floor.

5 Plate 8 projects internally of the container at flange 41: preferably, the free end of the plate is associated with a flange 81, or is bent in the form of an "L" so as to form said flange, projecting in cantilevered fashion from the body of said plate 8 and extending in a
10 longitudinal direction towards the oscillation axis O-O. Fastened to this flange is an electric contact point 82 preferably consisting of a drop of suitable conductive material, welded onto the flange surface. More particularly, the contact point 82 is fastened to the
15 surface of flange 81 facing the key. In this way the contact points 42 and 82 always face each other, in mutual register.

Resting on the base surface of said "U", i.e. of the
20 tilting contact element 40, facing the key is the end of a first helical spring 9 having the opposite end fitted in the key leg 3c, in abutment against the arms of said key. Preferably the spring end resting on the base of the tilting contact element is maintained in place by a
25 relief 43 in the form of a spherical cap radially projecting from said base towards the outside.

The length of spring 9 is slightly bigger than the distance between the key arms and the base of the tilting
30 contact element, so that said spring is compressed and in an unstable equilibrium in a straight configuration. Consequently it arranges itself in a curvilinear trajectory exerting a corresponding thrust on key 3 and on the tilting contact element 4: this thrust constrains
35 said elements to a predetermined position relative to the longitudinal direction. In particular it locks the

movable contact carrier 4 relative to the other contact carrier 5, either in a closed position for example, i.e. of mutual contact (Fig. 2), or in an open position, i.e. of mutual separation (Fig. 3). A convenient pressure exerted on the key surface reverses the spring curvature and consequently the mutual position of the two contact carriers. The contact carrier 5 was described and illustrated as a fixed contact carrier for the sake of simplicity in terms of explanation and representation, however in other alternative embodiments of the invention this contact carrier too can be movable and in particular it can oscillate around a corresponding fulcrum.

In accordance with the invention, the switch now described is provided with a thermoprotector device 6 comprising an element 61 alternately and elastically movable between an active position and a passive position, of non-interference and interference respectively with at least one of said activation means 3, 4 and 5, said element 61 being held in said active position by locking means 65 responsive to temperature variations, adapted to release said element 61 taking it to a passive position and locking it to said position, by effect of a predetermined temperature variation, said element 61 in said passive position locking said activation means 3 and/or 4 and/or 5 to one of said open or closed positions of said contact carriers.

In other words, the thermoprotector device 6 is substantially made up of a thermocouple for control of the temperature in a predetermined environment, which thermocouple when a threshold value, which is also predetermined, of said temperature is reached, activates a release device reversing the mutual position of the two contact carriers in a permanent manner.

- In a preferred embodiment of the invention, element 61 comprises a tubular preferably cylindrical case 62, rigidly connected to the switch casing which contains a hollow rod 63 freely slidable within said tubular case, in both ways, between a contracted position and an extracted position; this telescopic movement, in a radial direction, through floor 10, urges said rod 63 towards said key 3, preferably at one of said arms 3a, 3b.
- 10 Housed in the cavity of rod 63 is a second spring 64 working under compression which is disposed between the case base and the rod ceiling, to extract said rod at least partly from said case and urge it against said key. The spring 64 which is compressed when the
- 15 thermoprotector is in an active position, supplies energy to overcome the resistance of the first spring 9 when the rod 63 must change position of key 3 and/or of the contact carrier 4.
- 20 Preferably said locking means 65 comprises a thermocouple 66 disposed on the body of the tubular case 62 and rigidly connected therewith, which externally projects from the container casing and is provided with a laminar portion 67 extended along the rod and having the free end
- 25 formed with a stop pawl 68 adapted to be inserted in a corresponding notch 69 (Fig. 4) formed in the wall of said rod, so as to lock the rod in a contracted position with the spring 64 under compression.
- 30 Preferably said thermocouple has an elongated lamelliform shape rigidly connected, at one end, with said case and extended along the side surface of said rod, the opposite end of said laminar portion 67 being bent at an angle against said surface to form said stop pawl 68.

35

Preferably, notch 69 comprises a continuous annular

throat extending on the side surface of rod 63: this solution avoids rod 63 being restrained from rotating on its own axis in order to always ensure coupling between pawl 68 and notch 69.

5

Operation of the switch takes place as follows.

Fig. 2 shows the switch of the invention in a first position herein defined as closed position. Under this
10 situation flange 41 of the contact carrier 4 is inclined to the container floor, the contact carrier 4 and contact carrier 5 being in mutual contact; the electric supply circuit of the apparatus is closed. Rod 63 of the thermoprotector is in a contracted position, hooked by
15 the stop pawl 68 of thermocouple 65 and it does not interfere with the command key 3.

If it is wished to turn the apparatus off (Fig. 3) it is sufficient to exert a convenient pressure on the radially
20 external surface of the key. This pressure, that can be exerted alternately in the two end positions, causes rotation of key 3 around the transverse rotation axis R-R. Said key rotation changes the inclination of the key arms and therefore reverses the curvature of spring 9
25 inserted between the arms and the tilting contact element towards the longitudinally opposite direction: consequently spring 9 forces the tilting contact element 40 to longitudinally swing on its own fulcrum.

30 By effect of this change of inclination the switch takes a position defined as an open position through separation of contact carrier 4 from contact carrier 5, thereby opening the supply circuit of the apparatus. The thermoprotector is always in an active condition with
35 the rod in a contracted position. Rotation of the key moves the key arm away from the rod head, so that the rod

cannot interfere with said rotation. Under normal conditions the switch works in the same manner as in the absence of the thermoprotector.

5 If it is assumed that while the apparatus is working (Fig. 2) the thermocouple detects a temperature rise in the environment where it is housed that is higher than the predetermined value, by effect of this temperature rise the laminar portion 67 of the thermocouple bends and
10 the stop pawl 68 is drawn from notch 69.

Fig. 4 shows the just described situation. The rod 63, that is no longer retained by the stop pawl, is pushed by spring 63 against the arm of key 3 forcing it to reverse
15 its position and the associated position of the contact carrier 4, thereby bringing the switch from the closed to the open position, and deactivating the supply circuit.

As can be seen, the switch of the invention is now
20 locked: in fact, a temperature reduction does not succeed in producing a reverse rotation of the key, so as to close the supply circuit again, because the thermocouple is not structured for carrying out this operation. Even after cooling, the stop pawl provided on the free end of
25 the laminar portion 67 of the thermocouple is not able to hook the rod 63 again. Only an appropriate pressure exerted on key 3 by an operator can overcome the resistance of the spring 64 bringing the rod back to a contracted position, thereby enabling the stop pawl to be
30 inserted again in notch 69 so as to lock the thermoprotector to an active position, ready for a new intervention.

Obviously, at this point, the operator after finding out
35 the reason of the thermoprotector intervention will have done the necessary to eliminate the cause of said

intervention (bad operation or malfunction of the apparatus, for example).

At all events, until reset of the switch by said
5 operator, the switch keeps turned off so that the apparatus is protected against further damages and inconveniences.

A person skilled in the art will be able to conveniently
10 select the sizes and type of material of the elements forming the switch and in particular the thermoprotector device in order to control the time values, as well as the current intensity and temperature values causing intervention of the thermoprotector device.

15 The invention has a great number of advantages.

First of all, intervention of the thermoprotector takes place for a temperature increase of a predetermined
20 value, therefore also independently of the current passage in the controlled circuit. Taking into consideration the cases of a stove and of a short-circuited motor mentioned at the beginning, the remote control switch intervention or the thermostat
25 intervention take place immediately turning the power off from the supply circuit, but this does not inhibit a further heat generation within the apparatus. The thermoprotector device detects this heat generation but its intervention that may take place with some delay
30 with respect to intervention of said thermostat and remote control switch definitively breaks the supply current so that when the thermostat and/or remote control switch restore the electric contact, the apparatus is in any case switched off until intervention of the operator.

35 The switch has been described showing a condition of open

circuit after intervention of the thermoprotector but obviously depending on the type of the controlled circuit, the circuit could move from an open to a closed condition: in particular, said switch activating means
5 when the thermoprotector is in a passive position, can activate a signalling and/or alarm device.

The thermocouple has been described as adjacent to the thermoprotector but, actually, the release device
10 including the laminar portion or lamella 67 with the stop pawl 68 could be operated by a sensor placed in an environment different from that where the switch is housed, thereby enabling a remote control of said environment.

15 Intervention of the thermoprotector does not destroy the switch itself but puts it in a locked position that can be deactivated by an action carried out by an operator which is not automatic but conscious, said action
20 enabling the thermoprotector to be set again ready for operation, and the switch operation to be restored after each locking event.

The switch of the invention on the whole is of reduced
25 sizes, simple, reliable and inexpensive, with characteristics minimising the possibility of faults for the switch and prolonging duration of same in time: it mostly comprises mechanical elements already utilized in the known art for switches of large use and therefore it
30 has a reduced cost.

In the present description all possible structural and cinematic alternatives to the embodiments of the invention specifically described have not been
35 illustrated.

These variants however are intended to be included within the protective scope of the present patent, and these alternative embodiments can be easily identified from the description herein made of the relation existing between
5 each alternative embodiment and the result that the invention wishes to achieve.

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C L A I M S

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1. A safety switch, in particular for thermal protection of an electrical apparatus, comprising a container (1) inside which means (2) for activation of said switch is housed, said means comprising a command key (3) and a pair (4, 5) of contact carriers, movable relative to each other, each of them being connected with a terminal of its own of an electric circuit, at least one of said contact carriers (4) being susceptible of oscillation around an oscillation axis (O-O) between two positions, an open position at which said contact carriers are separated from each other and respectively a closed position, at which said contact carriers are in mutual contact, each of said positions being imposed by a corresponding position of said command key, said switch being characterized in that said activation means (2) comprises a device (6) responsive to temperature variations in the environment to be controlled, adapted to act on the electric supply circuit of said apparatus depending on the perceived heat level and carrying out a single action on said circuit, the possibility of reuse of the device after each action being bound to the intervention of an operator.

2. A safety switch as claimed in claim 1, characterized in that said device (6) comprises an element (61) that is alternately and elastically movable between an active position and a passive position, of non interference and interference respectively with at least one of said activation means (3, 4 and 5), said element (61) being held in said active position by locking means (65) responsive to temperature variations, adapted to free said element (61) taking it to a passive position and locking it to said position, by effect of a predetermined temperature variation, said element (61) in said passive

position locking said activation means (3 and/or 4 and/or 5) in one of said open or closed positions of said contact carriers.

5 3. A safety switch as claimed in claim 2, characterized in that said element (61) comprises a tubular case (62) rigidly connected with said container, inside which a hollow rod (63) is inserted which is freely slidable in both ways between a contracted position and an extracted
10 position, in said cavity being contained a spring (64) adapted to cause an at least partial extraction of said rod from said case towards said activation means.

4. A safety switch as claimed in claim 2, characterized
15 in that said locking means (65) comprises a thermocouple (66) rigidly connected with said case and a stop pawl (68) associated with said thermocouple and adapted to be inserted into a corresponding notch (69) formed in the side surface of said rod, when said rod is in said
20 contracted position.

5. A safety switch as claimed in claim 4, characterized in that said notch (69) comprises a continuous annular throat formed in said side surface.

25

6. A safety switch as claimed in claim 4, characterized in that said thermocouple (66) has an elongated lamelliform shape integral with said case at one end and extended along the side surface of said rod, the opposite
30 end of the laminar portion (67) being bent at an angle against said surface so as to form said stop pawl (68).

7. A safety switch as claimed in claim 3, inside which a command key (2) is housed which has a T-shaped
35 configuration with its arms extending in a longitudinal direction and the leg extended in a radial direction,

which key rotates in a longitudinal direction in the two ways around a transverse rotation axis R-R, passing through the "T" leg, a spring being fitted in the leg of said "T" and being disposed between said arms and said oscillating contact carrier (4), so as to impose an oscillation of said contact carrier as a consequence of a rotation of said key, and vice versa, characterized in that said rod (63) in a passive position interferes with said arm of said key.

10

8. A safety switch as claimed in claim 2, characterized in that in said interference position said contact carriers are mutually separated.

15

9. A safety switch as claimed in claim 7, characterized in that the thrust exerted by said spring (64) is stronger than that exerted by said spring (9).

20

10. A safety switch as claimed in claim 2, characterized in that said activation means, when said element (6) is in a passive position, activates a signalling and/or alarm device.

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A B S T R A C T

A safety switch, in particular for thermal protection of an electrical apparatus, comprises a container inside
5 which means for activation of said switch is housed, said means comprising a command key and a pair of contact carriers, that are movable and fixed respectively, and a thermoprotector device responsive to temperature variations in the environment to be
10 controlled and adapted to act on the electric supply circuit of said apparatus depending on the perceived heat level.

Said movable contact carrier oscillates between two positions, an open position at which said contact
15 carriers are separated from each other and respectively a closed position, at which said contact carriers are in mutual contact, each of said positions being imposed by a corresponding position of said command key.

The thermoprotector device acts in case of need on the
20 electric supply circuit and separates the contact carriers from each other by forcing the command key to the open position. This action deactivates the thermoprotector device and the switch therewith, and a new activation of the latter can only take place by
25 exerting a pressure on the command key capable of bringing the key again to the closed position and set the thermoprotector again ready for operation.

Fig. 2.

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